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(12) (19) (CA) **Demande-Application**

(21) (A1) **2,271,332**
(22) 1999/05/07
(43) 2000/02/25

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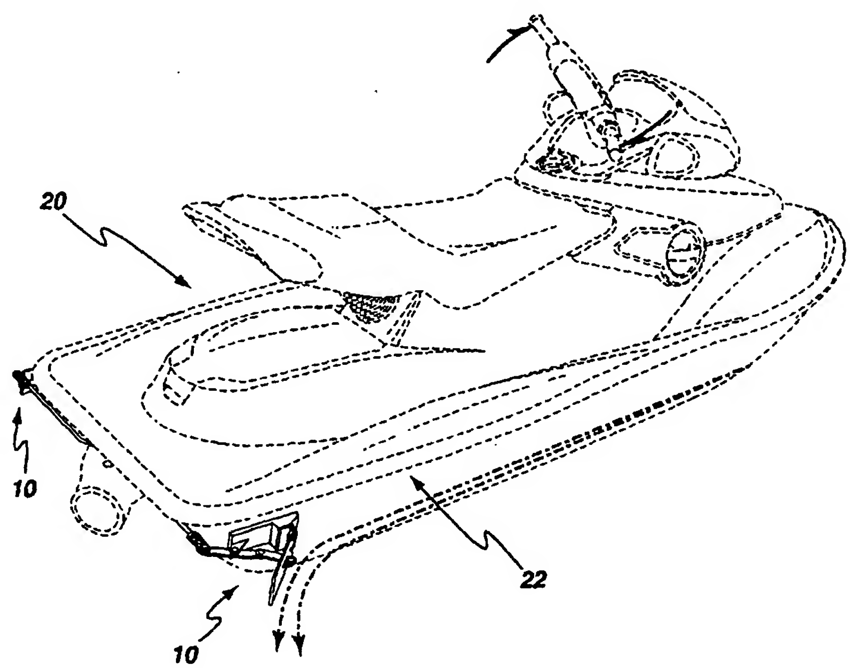
(51) Int.Cl.^{6} B63H 25/44
(30) 1998/08/25 (09/139,246) US

(54) **MECANISME DE COMMANDE DE VOLETS VERTICAUX POUR VEHICULE MARIN**

(54) **VERTICAL FLAP CONTROL MECHANISM FOR WATERCRAFT**



(57) A control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft, said force-generating angle is any angle between the water-contacting surface in its operative position and an instantaneous direction of travel of the watercraft. The mechanism further comprises a controller for actuating said control elements. The control elements can act asymmetrically to produce a steering effect or symmetrically to produce a deceleration effect.

ABSTRACT

A control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft, said force-generating angle is any angle between the water-contacting surface in its operative position and an instantaneous direction of travel of the watercraft. The mechanism further comprises a controller for actuating said control elements. The control elements can act asymmetrically to produce a steering effect or symmetrically to produce a deceleration effect.

The embodiments of the invention for which an exclusive pr perty r privilege is claimed are defined as follows:

1. A set of control elements for a watercraft having a hull adapted to float on and travel through a volume of water, said set of control elements comprising:

- a pair of water-contacting surfaces, symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, each water-contacting surface being movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft.

2. A set of control elements as defined in claim 1 wherein said force-generating angle is any angle between the water-contacting surface in its operative position and an instantaneous direction of travel of the watercraft.

3. A set of control elements as defined in claim 2 wherein said control elements act asymmetrically to produce a steering effect.

4. A set of control elements as defined in claim 3 wherein said control elements can also act symmetrically to produce a deceleration effect.

5. A set of control elements as defined in either claims 3 or 4 wherein said control elements are flap-like members.

6. A set of control elements as defined in claim 5 wherein said flap-like members are pivotally connectable to said watercraft.

7. A set of control elements as defined in claim 6 wherein each said flap-like member has a leading edge adapted for pivotal connection to said watercraft.

8. A set of control elements as defined in claim 6 wherein each said flap-like member has a trailing edge adapted for pivotal connection to said watercraft.

9. A set of control elements as defined in claim 6 wherein each said flap-like member is pivotally connectable to said watercraft at a point between a leading edge of said flap-like member and a trailing edge of said flap-like member.

10. A set of control elements as defined in claim 5 wherein said flap-like members are slidingly connectable to said watercraft.

11. A set of control elements as defined in claim 10 wherein each said flap-like member has a leading edge adapted for sliding connection to said watercraft.

12. A set of control elements as defined in claim 10 wherein each said flap-like member has a trailing edge adapted for sliding connection to said watercraft.

13. A set of control elements as defined in claim 10 wherein each said flap-like member is slidingly connectable to said watercraft at a point between a leading edge of said flap-like member and a trailing edge of said flap-like member.

14. A control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising:

(a) a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft; and

(b) a controller for actuating said control elements.

15. A control mechanism as defined in claim 14 wherein said force-generating angle is any angle between the water-contacting surface in its operative position and an instantaneous direction of travel of the watercraft.

16. A control mechanism as defined in claim 15 wherein said controller is connectable to a helm.

17. A control mechanism as defined in claim 15 wherein said controller is connectable to a steerable propulsion source.

18. A control mechanism as defined in either claims 15 wherein said controller further includes a pair of rigid links.

19. A control mechanism as defined in claim 18 wherein said controller further includes a slider-slot mechanism.

20. A control mechanism as defined in claim 15 wherein said controller further includes an actuator.

21. A control mechanism as defined in claim 15 wherein said controller further includes a pulley-cable system.

22. A control mechanism as defined in claim 15 wherein said controller further includes a motor and gear system.

23. A set of control elements for a watercraft having a hull adapted to float on and travel through a volume of water, said set of control elements comprising:

- a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, each said water-contacting surface movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and

angled in a force-generating angle, generates a force for decelerating the watercraft, said force having a component substantially opposite to the direction of travel of the watercraft.

24. A set of control elements as defined in claim 23 wherein said force-generating angle is any angle between the water-contacting surface in its operative position and an instantaneous direction of travel of the watercraft.

25. A set of control elements as defined in claim 24 wherein said control elements act symmetrically to produce a deceleration effect.

26. A set of control elements as defined in claim 25 wherein said control elements can also act asymmetrically to produce a steering effect.

27. A set of control elements as defined in either claim 25 or 26 wherein said control elements are flap-like members.

28. A set of control elements as defined in claim 27 wherein said flap-like members are pivotally connectable to said watercraft.

29. A set of control elements as defined in claim 28 wherein each said flap-like member has a leading edge adapted for pivotal connection to said watercraft.

30. A set of control elements as defined in claim 28 wherein each said flap-like member has a trailing edge adapted for pivotal connection to said watercraft.

31. A set of control elements as defined in claim 28 wherein each said flap-like member is pivotally connectable to said watercraft at a point between a leading edge of said flap-like member and a trailing edge of said flap-like member.

32. A set of control elements as defined in claim 27 wherein said flap-like members

are slidingly connectable to said watercraft.

33. A set of control elements as defined in claim 32 wherein each said flap-like member has a leading edge adapted for sliding connection to said watercraft.

34. A set of control elements as defined in claim 32 wherein each said flap-like member has a trailing edge adapted for sliding connection to said watercraft.

35. A set of control elements as defined in claim 32 wherein each said flap-like member is slidingly connectable to said watercraft at a point between a leading edge of said flap-like member and a trailing edge of said flap-like member.

36. A control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising:

(a) a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft, said force having a component substantially opposite the instantaneous direction of travel of the watercraft; and

(b) a controller for actuating said control elements.

37. A control mechanism as defined in claim 36, further comprising a controller for actuating said control elements.

38. A control mechanism as defined in claim 37 wherein said controller is connectable to a helm.

39. A control mechanism as defined in claim 37 wherein said controller is connectable to a steerable propulsion source.

40. A control mechanism as defined in claim 37 wherein said controller further includes a pair of rigid links.

41. A control mechanism as defined in claim 40 wherein said controller further includes a slider-slot mechanism.

42. A control mechanism as defined in claim 37 wherein said controller further includes an actuator.

43. A control mechanism as defined in claim 37 wherein said controller further includes a pulley-cable system.

44. A control mechanism as defined in claim 37 wherein said controller further includes a motor and gear system.

45. A control mechanism as defined in claim 39 wherein said controller comprises:

- a rigid link having one end connectable to said steerable propulsion source;
- a slider-slot connected to a second end of said rigid link;
- a pivoting member connected at one end to said slider and movable within said slot and pivotally connected to said watercraft;
- a flap having a leading edge pivotally mountable to said watercraft, said flap being connected to said pivoting member such that displacement of the rigid link causes the flap to move between said inoperative position to one of said plurality of operative positions.

Vertical Flap Control Mechanism for Watercraft

Field of the Invention

The present invention relates to a control mechanism for watercraft and, more particularly, to a control mechanism for steering and decelerating personal watercraft.

Background of the Invention

In recent years, the demands of racers and recreational users alike for greater performance and maneuverability have driven the designers of personal watercraft to reconsider the control mechanisms traditionally used for steering and decelerating. In general, steering and decelerating can be achieved in a variety of manners, either independently of one another or synergistically.

Essentially, the steering of a boat can be achieved by either turning the source of propulsion, such as an outboard motor or a jet-boat nozzle, or by actuating the boat's control surfaces. These control surfaces can be substantially vertical such as the common rudder on a stern drive or they can be substantially horizontal, such as flaps and tabs.

Examples of steering mechanisms involving vertical fins or rudders are found in US Patents 4,615,290 and 4,632,049, issued to Hall et al., and in US Patent 4,352,666, issued to McGowan. However, since these fins and rudders are mounted at the stern of the watercraft and remain close to the plane of symmetry of the hull, the steering effect that such a rudder produces is often not sufficient for a high-performance watercraft. In other words, rudders are typically employed on slow-moving ships where sharp turning is not a prerequisite.

Decelerating can generally be accomplished in one of three ways: by either reversing thrust, by redirecting the thrust toward the bow of the watercraft, or by creating drag by introducing a control surface at least partially perpendicular to the watercraft's direction of travel.

Decelerating by reversing thrust is perhaps the most common technique, simply requiring the propellor to turn backwards. The main problem associated with this technique is that decelerating is slow due to the time lag required to stop and then to reverse the propellor.

Redirecting the thrust toward the bow is a decelerating technique currently employed by numerous personal watercraft. Examples of thrust-reversing buckets or reverse gates have been disclosed by Kobayashi et al. in US Patents 5,062,815, 5,474,007, 5,607,332, 5,494,464 as well as by Nakase in US Patent 5,154,650. Although these thrust-reversing buckets direct the water jet backwards, they also have a propensity to direct the water jet *downwards*. This downward propulsion lifts the stern of the watercraft and causes the bow to dive. The sudden plunging of the bow not only makes the watercraft susceptible to flooding and instability but also makes it difficult for the rider to remain comfortably seated and firmly in control of the steering column.

The use of control surfaces for decelerating is disclosed by Mardikian in US Patent 5,092,260. Mardikian's brake mechanism for personal watercraft involves a hinged flap on the ride plate at the stern of the boat capable of being angled into the water to slow the boat. However, such downward-sweeping stern flaps or tabs unfortunately also elevate the stern.

Finally, steering, decelerating and trimming can be performed synergistically. Mardikian's US Patent 5,193,478 discloses an adjustable brake and control flaps for steering, decelerating and trimming a watercraft. The flaps, located at the stern, in their fully declined position act as powerful brakes for the boat. Differential declination of

the flaps results in trimming and steering of the boat. The flaps provide steering, decelerating and trimming in a manner analogous to the flaps and ailerons of an aircraft. During sharp decelerations, however, the downward sweep of the tabs causes the stern to rise and the bow of the personal watercraft to plunge, often creating the potential for flooding and instability. Not only is the plunging of the bow uncomfortable for the rider but the watercraft is more difficult to control during hard decelerating maneuvers.

Thus, there is a need in the industry for an improved control mechanism for watercraft that overcomes the defects and shortcomings described above.

Objects and Statement of the Invention

It is thus an object of the present invention to provide a set of control elements for a watercraft for high-performance steering and decelerating of said watercraft.

It is another object of the present invention to provide a set of control elements for a watercraft capable of steering and decelerating said watercraft when the throttle is cut and no propulsion is available.

It is another object of the present invention to provide a set of control elements for a watercraft capable of steering and decelerating the watercraft without causing the bow of the watercraft to pitch forward.

It is another object of the present invention to provide a set of control elements for a watercraft capable of steering and decelerating the watercraft without adversely affecting the horizontal attitude, or pitch, of the watercraft.

It is another object of the present invention to provide a control mechanism for watercraft for high-performance steering and decelerating of said watercraft wherein the

control mechanism is directly linked to the main steering mechanism for easy use.

It is another object of the present invention to provide a control mechanism comprising control elements possessing the aforementioned features and advantages.

It is another object of the present invention to provide a watercraft comprising a control mechanism possessing the aforementioned features and advantages.

As embodied and broadly described herein, the present invention provides a set of control elements for a watercraft having a hull adapted to float on and travel through a volume of water, said set of control elements comprising a pair of water-contacting surfaces, symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, each water-contacting surface being movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft. Such a set of control elements allows the watercraft to be steered in a very easy and efficient manner. With the control elements located on the starboard and port sides of the watercraft, the steering effect that is produced when these elements engage the water is greater than the steering effect that would be produced by a similarly sized rudder located at the stern of a similar watercraft. The greater steering effect is simply a result of the positioning of the elements at a greater distance from the plane of symmetry of the watercraft than is possible with a conventional stern-mounted rudder. Furthermore, since the elements act in a plane generally parallel to the direction of travel of the watercraft (i.e. in a generally horizontal plane) as opposed to the prior art tabs that operate in a generally vertical plane (i.e. perpendicular to the direction of travel of the watercraft), the control elements of the present invention do not adversely affect the attitude, or pitch, of the watercraft. The control elements of the present invention lift neither the bow nor the stern of the watercraft thus enhancing the overall stability of the watercraft especially during high-speed maneuvering.

Preferably, the control elements can also act symmetrically to produce a deceleration effect. When the control elements are opened concurrently, an equal drag force is produced on both sides of the watercraft, thereby ensuring a stable deceleration. This arrangement allows the watercraft to be both steered and decelerated using the control elements. The watercraft's control elements serve to magnify the steering effect produced by the steerable propulsion source. The control elements also serve to steer and decelerate the watercraft when the throttle is cut and there is no thrust being produced by the steerable propulsion source. For instance, when approaching a dock or beach, it may be advantageous to cut the throttle and to guide the watercraft to its berth by actuating the control elements.

Preferably, the control elements are flap-like members that are pivotally connectable to said watercraft. A pivotal flap-like member is a simple mechanism to design and manufacture. It is inexpensive to construct and reliable and practically maintenance-free in operation. Such a pivotal flap-like member can be advantageously flush with the hull in its inoperative position and then simply angled into the water by any simple mechanism to exert a drag force on the watercraft. A pivotal flap-like member is advantageous, furthermore, because it generates a smooth increase in drag as it is progressively introduced into the water and thus does not produced sudden, harsh decelerations.

As embodied and broadly described herein, the present invention provides a control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft, and a controller for actuating said control elements. Such a control mechanism has a controller for easily and efficiently actuating the control elements. Preferably, the

controller is linked to either the helm, or steering wheel, or to the steerable propulsion source. With such an arrangement, the driver of the watercraft need only turn the helm and the control elements will automatically be actuated to enhance the steering effect of the steerable propulsion source.

As embodied and broadly described herein, the present invention provides a set of control elements for a watercraft having a hull adapted to float on and travel through a volume of water, said set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, each said water-contacting surface movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force for decelerating the watercraft, said force having a component substantially opposite to the direction of travel of the watercraft. Such a set of control elements provides the watercraft with a means for decelerating. While other prior art deceleration mechanisms generally adversely affect the attitude or pitch of the watercraft, especially when activated at high-speeds, the present invention provides a means to decelerate the watercraft without causing the bow or stern to lift. This enhances the overall stability of the watercraft and improves its performance.

Preferably, the control elements can also act asymmetrically to produce a steering effect. This arrangement allows the watercraft to be both steered and decelerated using the same control elements. The watercraft's control elements serve to magnify the steering effect produced by the steerable propulsion source. The control elements also serve to steer and decelerate the watercraft when the throttle is cut and there is no thrust being produced by the steerable propulsion source. For instance, when approaching a dock or beach, it may be advantageous to cut the throttle and to guide the watercraft to its berth by actuating the control elements.

Preferably, the control elements are flap-like members that are pivotally connectable to said watercraft. A pivotal flap-like member is a simple mechanism to

design and manufacture. It is inexpensive to construct and reliable and practically maintenance-free in operation. Such a pivotal flap-like member can be advantageously flush with the hull in its inoperative position and then simply angled into the water by any simple mechanism to exert a drag force on the watercraft. A pivotal flap-like member is advantageous, furthermore, because it generates a smooth increase in drag as it is progressively introduced into the water and thus does not produced sudden, harsh decelerations.

As embodied and broadly described herein, the present invention provides a a control mechanism for a watercraft having a hull adapted to float on and travel through a volume of water, said mechanism comprising a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft, said force having a component substantially opposite the instantaneous direction of travel of the watercraft; and a controller for actuating said control elements. Such a control mechanism has a controller for easily and efficiently actuating the control elements. Preferably, the controller is linked to either the helm, or steering wheel, or to the steerable propulsion source. With such an arrangement, the driver of the watercraft need only turn the helm and the control elements will automatically be actuated to enhance the steering effect of the steerable propulsion source.

As embodied and broadly described herein, the present invention provides a watercraft having a control mechanism comprising a set of control elements comprising a pair of water-contacting surfaces symmetrically disposed with respect to the general longitudinal plane of symmetry of the watercraft, said water-contacting surfaces movable between an inoperative position and a plurality of operative positions in which, when in contact with said volume of water along a lateral wall of the hull and angled in a force-generating angle, generates a force having a steering effect on the watercraft,

said force having a component substantially opposite the instantaneous direction of travel of the watercraft; and a controller for actuating said control elements. Such a control mechanism has a controller for easily and efficiently actuating the control elements. Preferably, the controller is linked to either the helm, or steering wheel, or to the steerable propulsion source. With such an arrangement, the driver of the watercraft need only turn the helm and the control elements will automatically be actuated to enhance the steering effect of the steerable propulsion source.

Other objects and features of the invention will become apparent by reference to the following description and the drawings.

Brief Description of the Drawings

A detailed description of the preferred embodiments of the present invention is provided hereinbelow, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a watercraft control mechanism according to the present invention mounted to a typical watercraft;

Figure 2 is a perspective view of a watercraft control mechanism of Figure 1 wherein the watercraft is turning to starboard;

Figure 3 is a top plan view of a watercraft control mechanism according to the present invention;

Figure 4 is a top plan view of the watercraft control mechanism of Figure 3 wherein the watercraft is turning to starboard;

Figure 5 is a top plan view of the port side of the control mechanism of Figure 3;

Figure 6 is a top plan view of a variant of the mechanism of Figure 3;

Figure 7 is a top plan view of a second variant of the mechanism of Figure 3;

Figure 8 is a top plan view of a third variant of the mechanism of Figure 3;

Figure 9 is a rear elevational view of the variant of Figure 8;

Figure 10 is a top plan view of a fourth variant of Figure 3;

Figure 11 is a top plan view of a fifth variant of Figure 3;

Figure 12 is a top plan view of a sixth variant of Figure 3;

Figure 13 is a top plan view of a seventh variant of Figure 3;

Figure 14 is a top plan view of a eighth variant of Figure 3;

Figure 15 is a top plan view of a ninth variant of Figure 3;

Figure 16 a top plan view of a tenth variant of Figure 3; and

Figure 17 is a top plan view of an eleventh variant of Figure 3.

In the drawings, preferred embodiments of the invention are illustrated by way of examples. It is to be expressly understood that the description and drawings are only for the purpose of illustration and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

Detailed Description of Preferred Embodiments

Figures 1 to 17 show a control mechanism for a watercraft according to the present invention. As depicted in Figure 1, this control mechanism has control elements that can be displaced into contact with a volume of water surrounding the watercraft in order to produce a drag force. When the control elements act independently of one another as shown in Figure 2, a steering effect is produced. When the control elements act synchronously, two equal drag forces are produced on either side of the watercraft, the result of which is a deceleration of the watercraft. A control mechanism is preferably linked to the steerable propulsion source or to the helm of the watercraft so that when the watercraft's steerable propulsion source is turned, the control elements contribute a supplementary steering effect. Furthermore, when the throttle is cut and no propulsive thrust is being produced by the steerable propulsion source, the control elements can still be actuated to steer or decelerate the watercraft. This provides the watercraft with "no-thrust steering" capability. One of the primary advantages of this control mechanism is that the control elements, due to their novel orientation, do not adversely affect the pitch or attitude of the watercraft when the control elements are actuated, especially at high speeds. Thus, this control mechanism enhances the performance and maneuverability of the watercraft.

In a preferred embodiment, as shown in Figures 3-5, a set of control elements 10 for a watercraft 20 having a hull 22 adapted to float on and travel through a volume of water 5 comprises a pair of water-contacting surfaces 12 symmetrically disposed with respect to the general plane of symmetry 25 of the watercraft. Each water-contacting surface 12 is movable between an inoperative position 34 and a plurality of operative positions 36. In one of the operative positions 36, the water-contacting surface 12 is angled in a force-generating angle 37 and generates a force 15 having a steering effect on the watercraft 20. In an operative position 36, the control elements 10 at least partially obstruct the slipstream of water by the hull 22. This obstruction produces a drag force on the watercraft.

As illustrated in Figure 5, the force-generating angle 37 is preferably construed to be any angle between the water-contacting surface 12 when the control element 10

is in its operative position 36 and an instantaneous direction of travel 14 of the watercraft 20.

Preferably, the control elements 10 can act asymmetrically to produce a steering effect. Any differential actuation of the control elements 10 produces a drag force on one side of the watercraft that is greater than the drag force on the other side. This imbalance of drag forces produces a steering effect. To steer to starboard, the starboard control element must exert a larger drag force than the port control element. Conversely, to steer to port, the port control element must exert a larger drag force than the starboard control element.

Preferably, the control elements 10 can also act symmetrically to produce a deceleration effect. If both control elements 10 produce equal drag forces on either side of the watercraft (i.e. drag forces that are symmetrical about the plane of symmetry 25) then the watercraft neither turns to starboard nor to port and simply decelerates in a generally straight line.

Most preferably, the flap-like members are adapted to either open symmetrically or to open asymmetrically (with respect to the plane of symmetry 25 of the hull of the watercraft.) This either steers or decelerates the watercraft.

The control elements 10 are preferably flap-like members 30 with a large surface-area-to-weight ratio (since the surface area of the flap-like members determine the drag force that is produced). The flap-like members 30 are advantageously flat flaps that produce a smooth increase in drag as they are introduced into the water. Alternatively, however, the flap-like members can be made in practically any shape so long as the flap-members generate a hydrodynamic drag force sufficiently large as to noticeably steer or decelerate the watercraft 20. Most preferably, of course, the flap-like members 30 are constructed of a substantially rigid, non-soluble and non-corrosive material. It is also preferable that the flap-like members 30 be shaped so as to produce a smooth increase in drag as the flap-like members 30 are introduced into the water so

as to not destabilize the watercraft 20, especially during high-speed maneuvering.

While it is most preferable that the flap-like members 30 be flat flaps, there are at least three other alternative types of flap-like members that can be implemented. One such type of flap-like members comprises ridges or grooves for directing the slipstream of water either upwards or downwards. In another type, the flap-like members are disposed with a surface roughness to augment turbulent drag. In a third type, the flap-like members are provided with a pressure-release mechanism like a spring-loaded mini-flap that opens when the force of water impinging on the flap-like member becomes excessively large. Such a spring-loaded mini-flap preferably includes a rotational spring for connection to the flap-like member. When the force of water impinging on the mini-flap exceeds the force generated by the rotational spring, the mini-flap is pushed open. When the force of water impinging on the mini-flap diminishes (e.g. when the watercraft slows down) the rotational spring returns the mini-flap so that it is generally flush with the surface of the flap-like member.

In this first embodiment, it is preferable that the flap-like members 30 be positionable in any intermediate position between the extreme limits of motion of the flap-like members 30. The extreme limits of motion are the most-open operative position 36 and the totally closed inoperative position 34. If the flap-like members 30 are positionable in any intermediate position between the extreme limits of motion, then the control elements 10 can produce a full range of drag forces for steering and decelerating the watercraft 20. This greatly enhances the driver's control of the watercraft since fine adjustments to the watercraft can be made by slightly displacing the flap-like members 30.

The flap-like members 30 are preferably pivotally connectable to the watercraft as shown in Figures 1-7. Alternatively, the flap-like members can be slidingly connectable to the watercraft 20 as illustrated in Figures 8 and 9.

Preferably, the flap-like members are pivotally connectable to the watercraft at

the leading edge of each flap-like member as shown in Figures 1-6. Alternatively, the flap-like members 30 are pivotally connectable to the watercraft at the trailing edge of each flap-like member as shown in Figure 7. Alternatively, the flap-like members 30 are pivotally connectable to the watercraft at a point between the leading edge and the trailing edge. Analogously, the flap-like members can be slidingly connectable to the watercraft at either the leading edge, trailing edge or a point therebetween.

In another embodiment, a control mechanism 50 comprises a pair of control elements 10 as described above and further comprises a flap controller 40 connected to the flap-like members 30. The flap controller 40 permits the driver of the watercraft to displace each flap-like member 30 between the inoperative position 34 and the operative position 36 for steering and/or decelerating the watercraft. The flap controller 40 is connected to either a steerable propulsion source or a helm. Examples of a steerable propulsion source are a jet-boat nozzle or an outboard motor. When either the steerable propulsion source or the helm is turned, the flap controller 40 is displaced in such a manner as to actuate the flap-like members 30. Preferably, the control mechanism 50 also includes a decelerator mechanism 52 (such as a pedal and cable system) for synchronously actuating the flap-like members 30.

In a first variant, the flap controller 40 includes a pair of rigid links for actuating the flap-like members 30. The rigid links are preferably pivotally connected to the steerable propulsion source.

In a second variant, the flap controller 40 further includes a slider-slot mechanism coupled to the rigid links to allow either one of the flap-like members to be actuated without necessarily actuating the other flap-like member. In other words, a single flap controller 40 can be used to independently actuate both flap-like members.

In a third variant, the flap controller 40 comprises a pulley-cable assembly, as illustrated in Figures 14, 15, 16 and 17, to either pivotally or slidingly displace the flap-

like members 30. The pulley-cable assembly connects the flap-like members to the steerable propulsion source or to the helm. It is most advantageous to employ a pair of pulleys around which the respective cables can be routed. One of the priimary advantages of the pulley-cable system is that the cables can be easily routed around the pre-existing structure of the watercraft. In other words, there is no need to redesign the watercraft to accommodate the control mechanism.

In a fourth variant, the flap controller 40 comprises an actuator, preferably a pneumatic or hydraulic actuator. Most preferably, as illustrated in Figure 11, the flap controller 40 comprises two actuators, a starboard actuator 61 and a port actuator 62, each actuator being capable of exerting a pushing and pulling force to open and close the flap-like members 30. The hydraulic or pneumatic pressure necessary to drive the actuators can be generated by a pressure-charger running off a main propulsion shaft or by a pressure-charger running off a turbine in the case of a jet-boat.

In a fifth variant, the flap controller 40 comprises a motor and gear system 70 as illustrated in Figure 10. Preferably, the motor is electric and the amperage and voltage necessary for running the motor is advantageously generated by an alternator connected to the main propulsion source. Alternatively, the motor could be gas-powered. It is preferable that the motor be linked via at least one gear or a gearbox to the flap-like members. The gears would augment the torque output by the motor in order to quickly open and close the flap-like members at high speed.

In a sixth variant, the flap-controller 40 comprises a belt-drive unit and clutch system to operate the flap-like members 30. The belt-drive would normally run off an output shaft of the main propulsion source. When the steerable propulsion source or the helm is turned, the clutch engages the belt-drive unit. The rotary motion of the belt-drive unit thus becomes coupled to a rotation-to-translation mechanism, for instance a screw-drive 90. The screw-drive 90, illustrated in Figures 12 and 13, in turn displaces the flap-like members 30 from the inoperative position 34 to the operative position 36.

In embodiments of the watercraft control mechanism described above, it may be advantageous to further include a spring or damper in the flap controller mechanism in order to bias the flap toward either the closed, inoperative position 34 or the open, operative position 36. Furthermore, the use of a damper in the flap controller 40 would make the opening and closing of the flap-like members 30 smoother and more controlled.

The variants described above may be combined in any number of possible ways to produce functionally equivalent watercraft control mechanism. For example, an actuator or motor can be used to exert a force on a cable which, in turn, actuates a pair of flaps via a pulley. Alternatively, the rotary motion of the main shaft of the main propulsion source can be converted by a suitable transmission to produce a force necessary to open and close the flaps. Yet another variant of the watercraft control mechanism would comprise a pair of inner lateral ducts to divert the water that is sucked into the jet propulsion towards a starboard outlet and a port outlet. The high-speed jet of water exiting from either the starboard outlet or the port outlet would then impinge on the inner surface of the respective starboard or port flap. The force of the water impinging on the flap would cause the flap to open.

The above description of preferred embodiments should not be interpreted in a limiting manner since other variations, modifications and refinements are possible within the spirit and scope of the present invention. The scope of the invention is defined in the appended claims and their equivalents.

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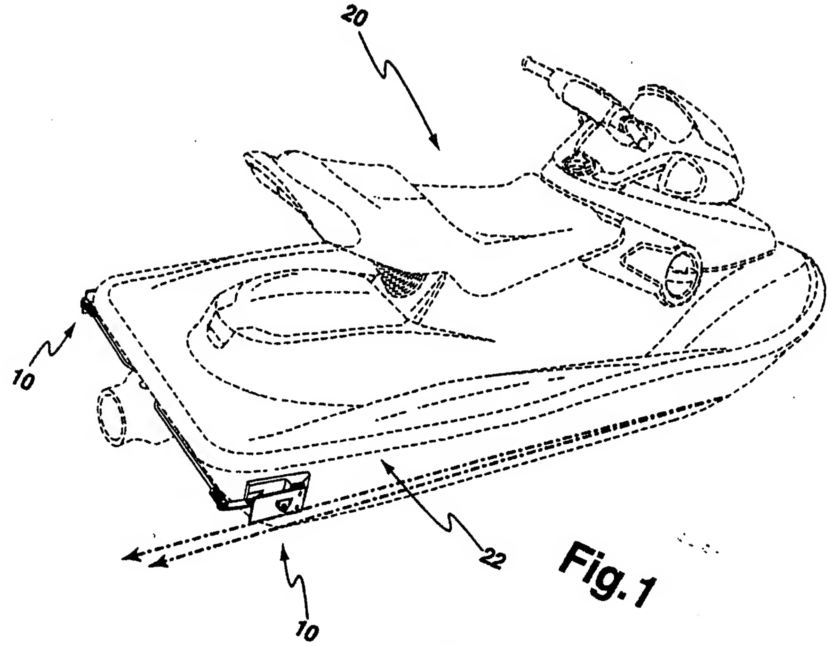

Fig.1

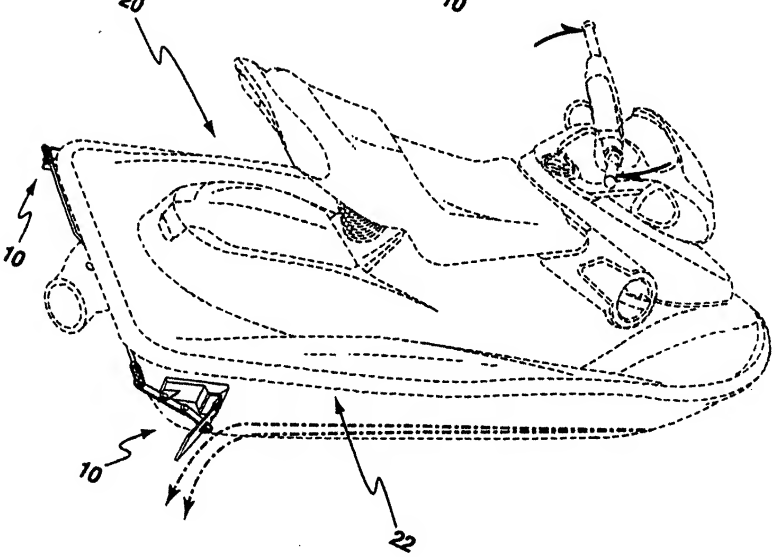

Fig.2

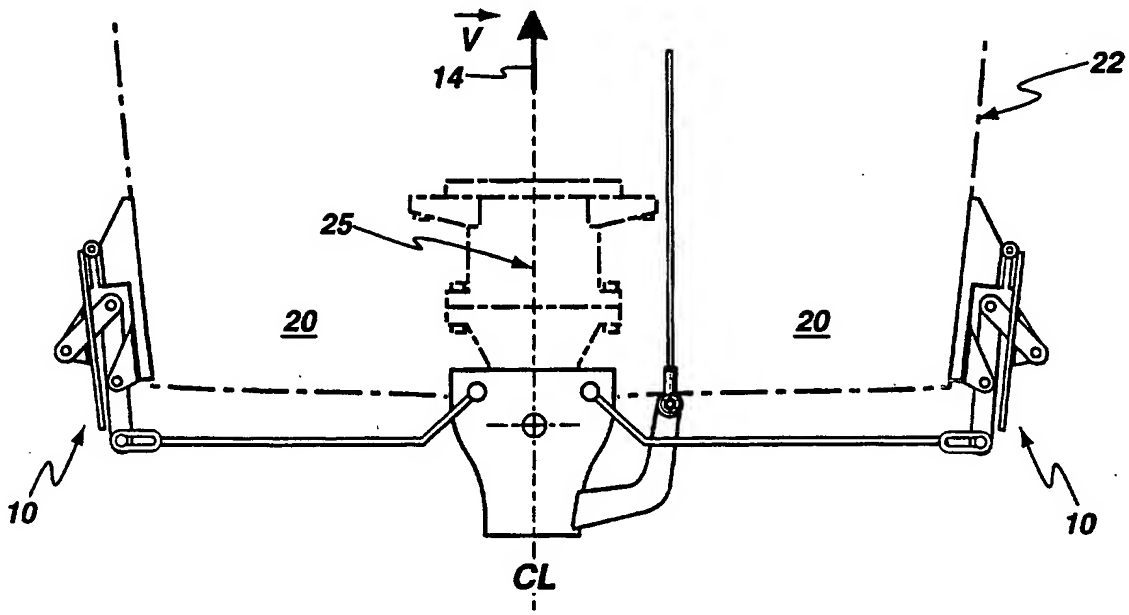

Fig.3

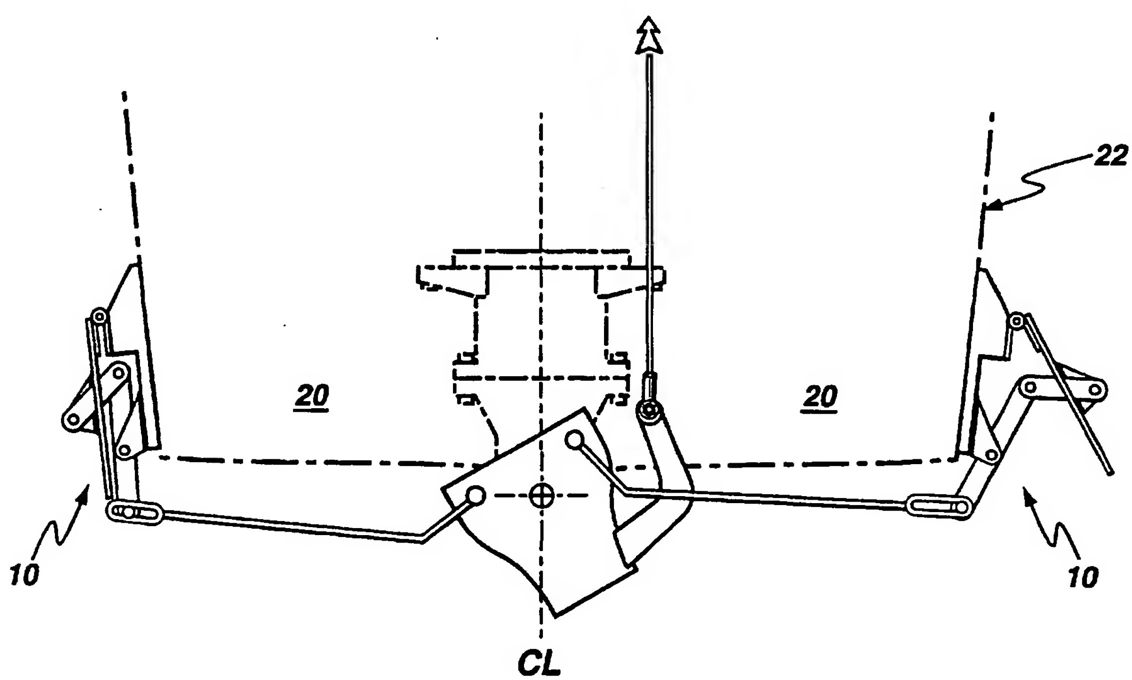

Fig.4

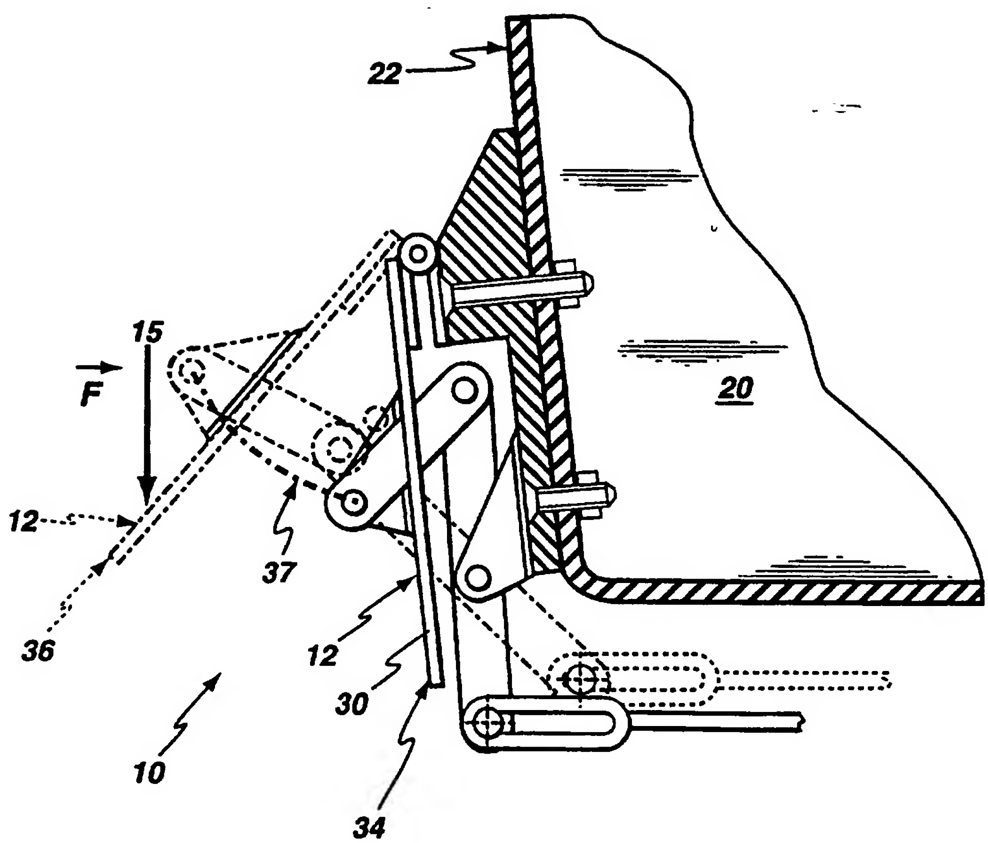

Fig.5

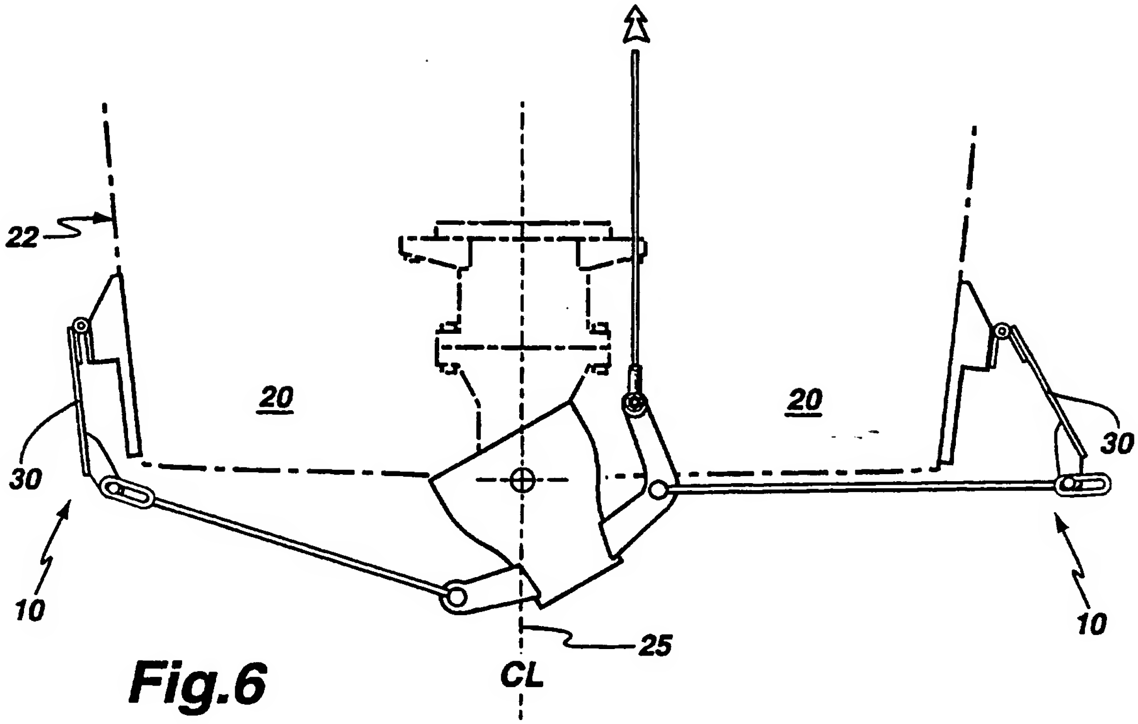

Fig.6

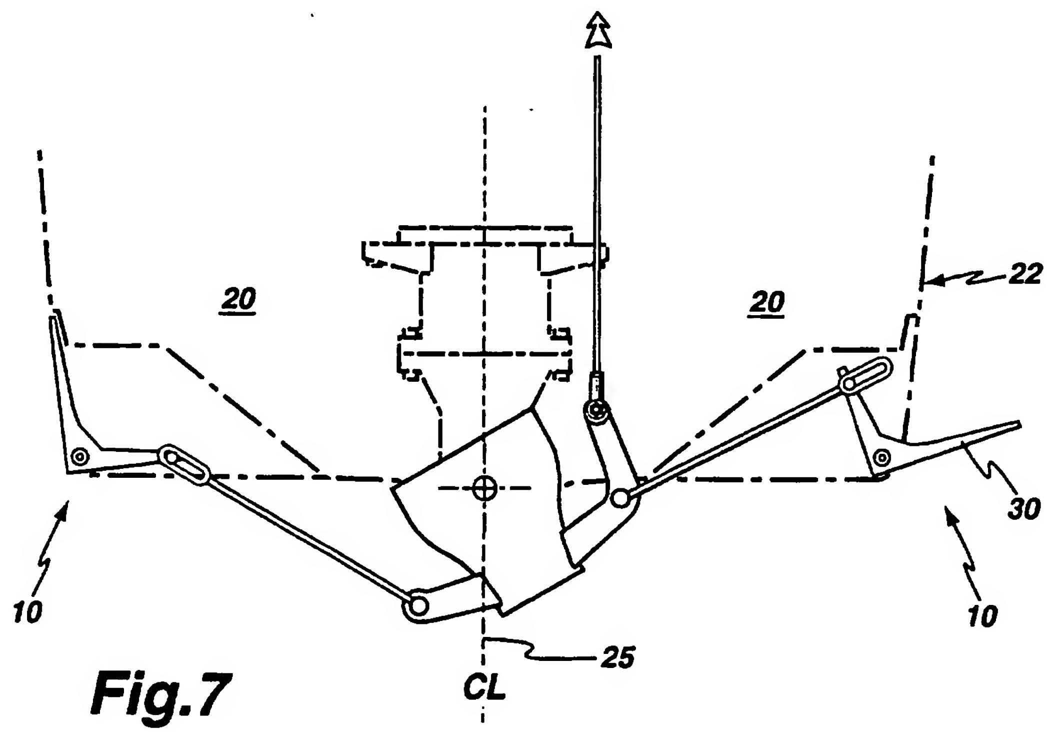

Fig.7

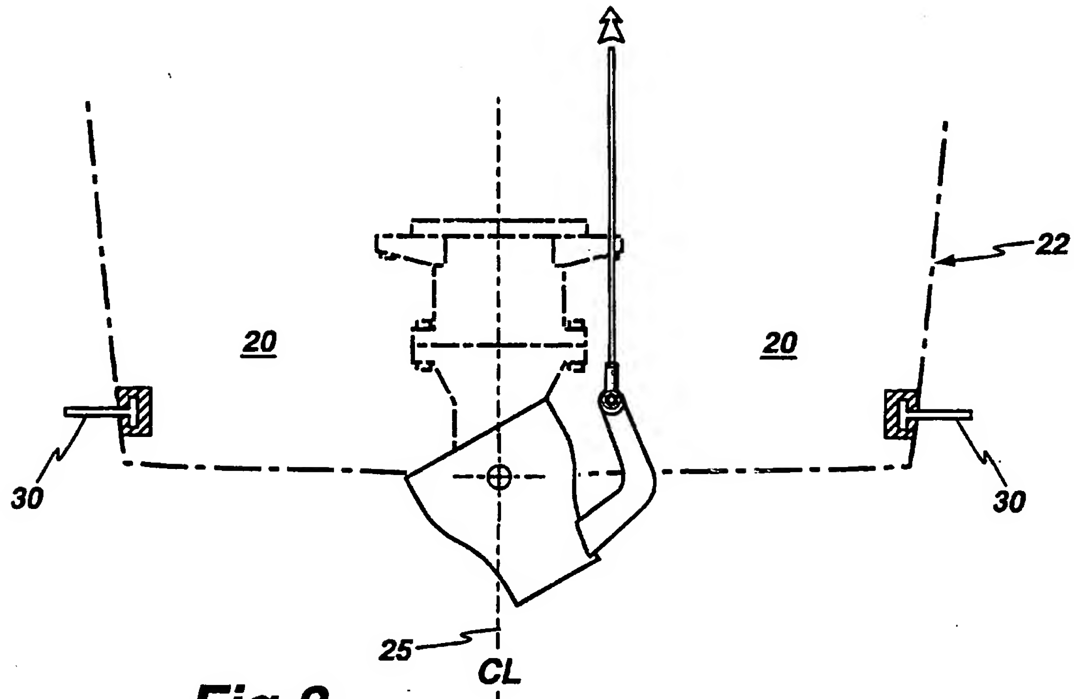

Fig.8

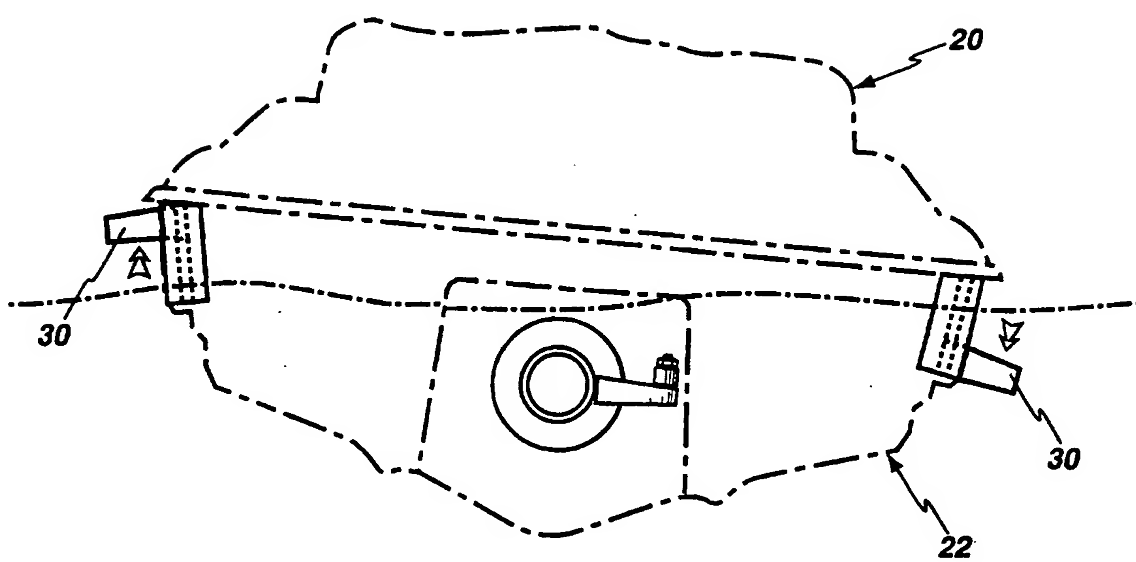

Fig.9

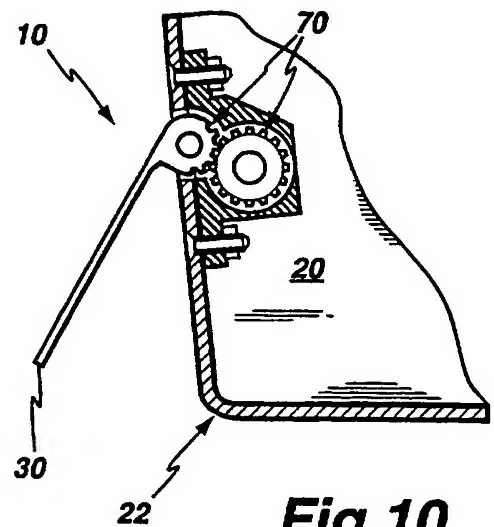

Fig.10

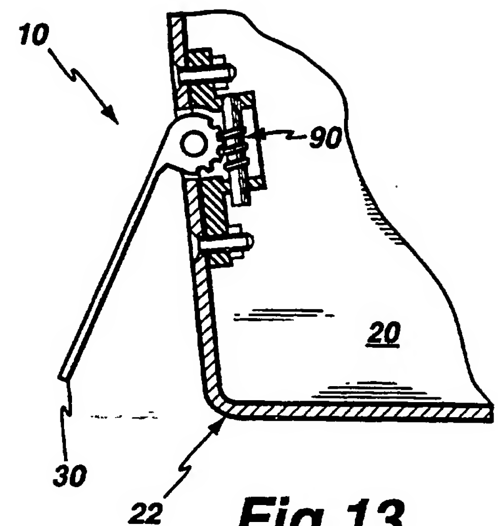

Fig.13

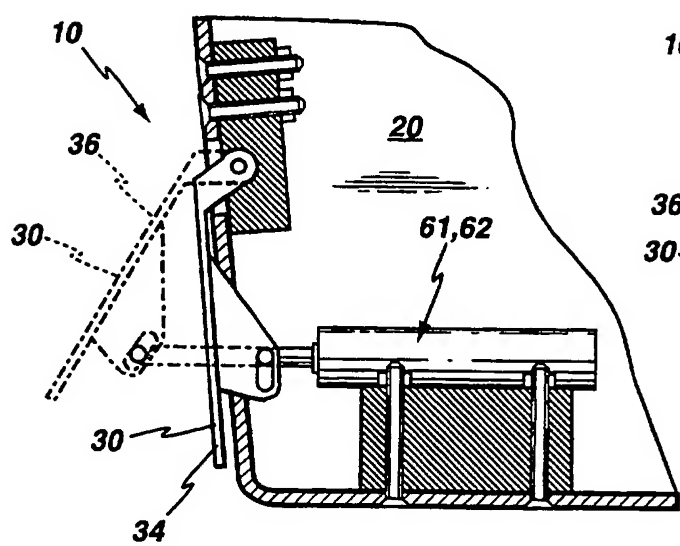

Fig.11

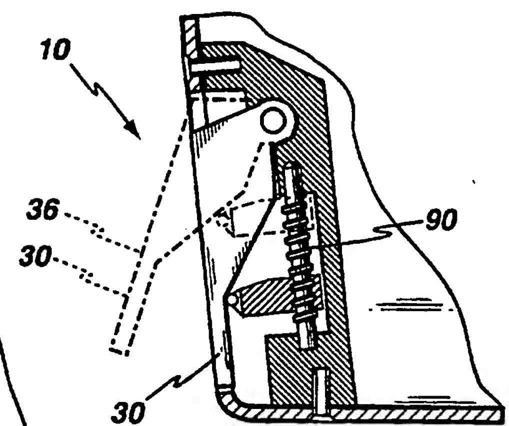

Fig.12

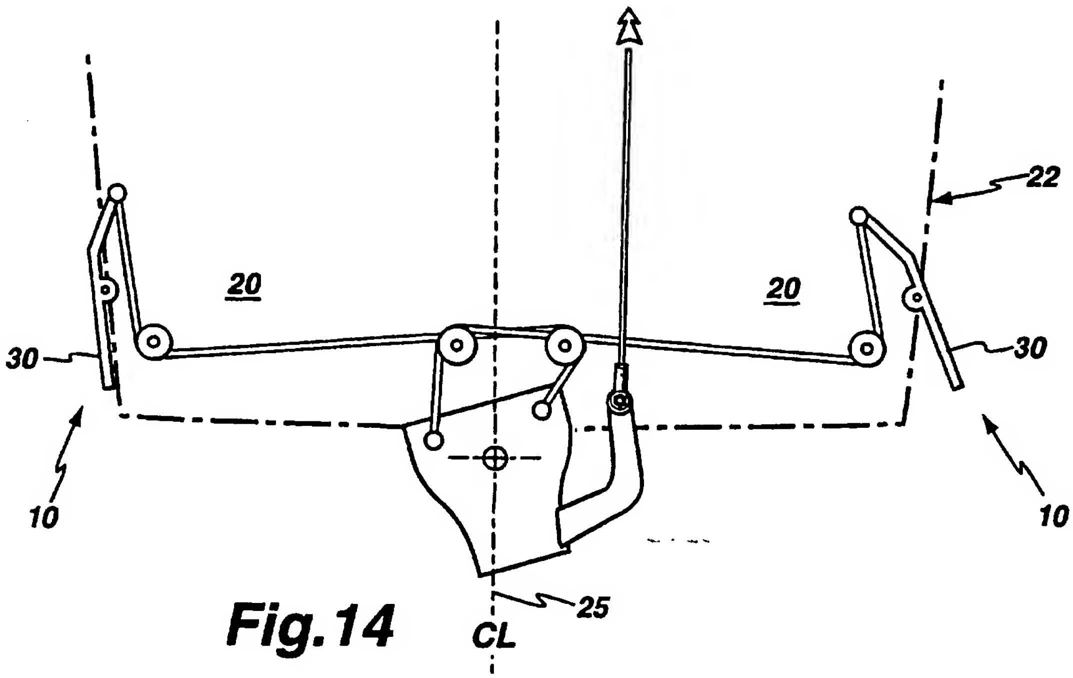

Fig.14

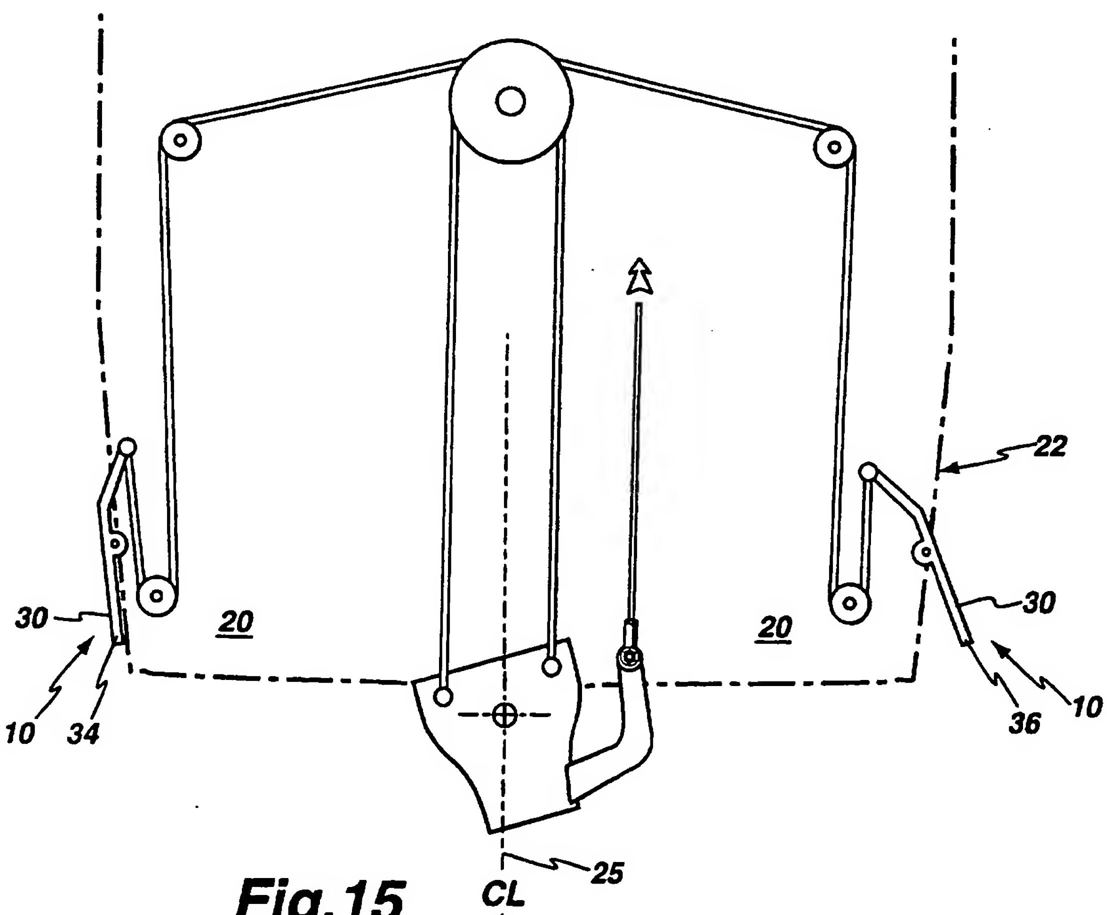

Fig.15

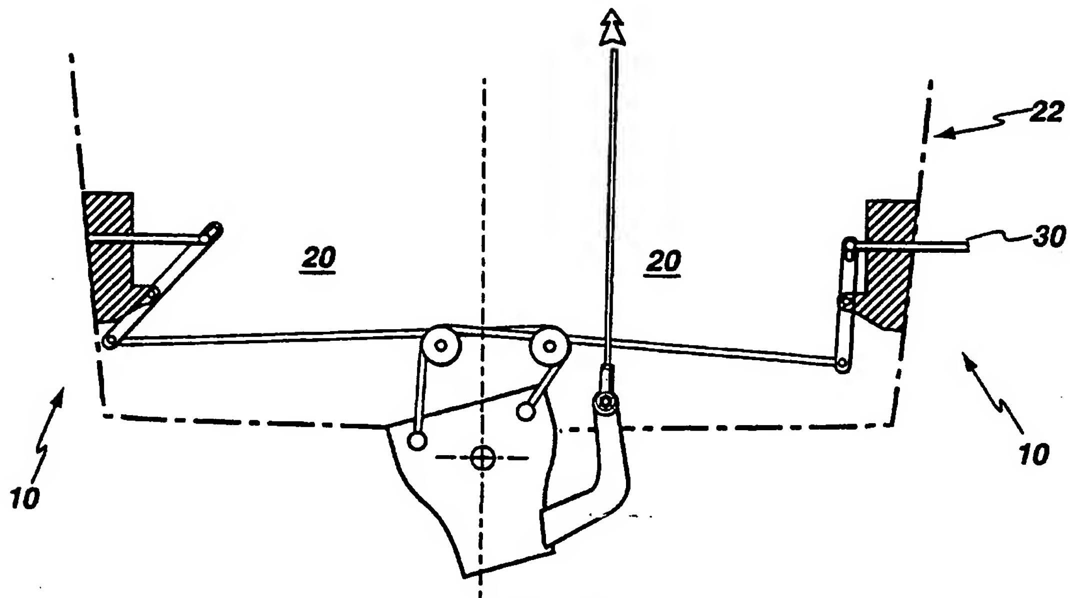

Fig.16

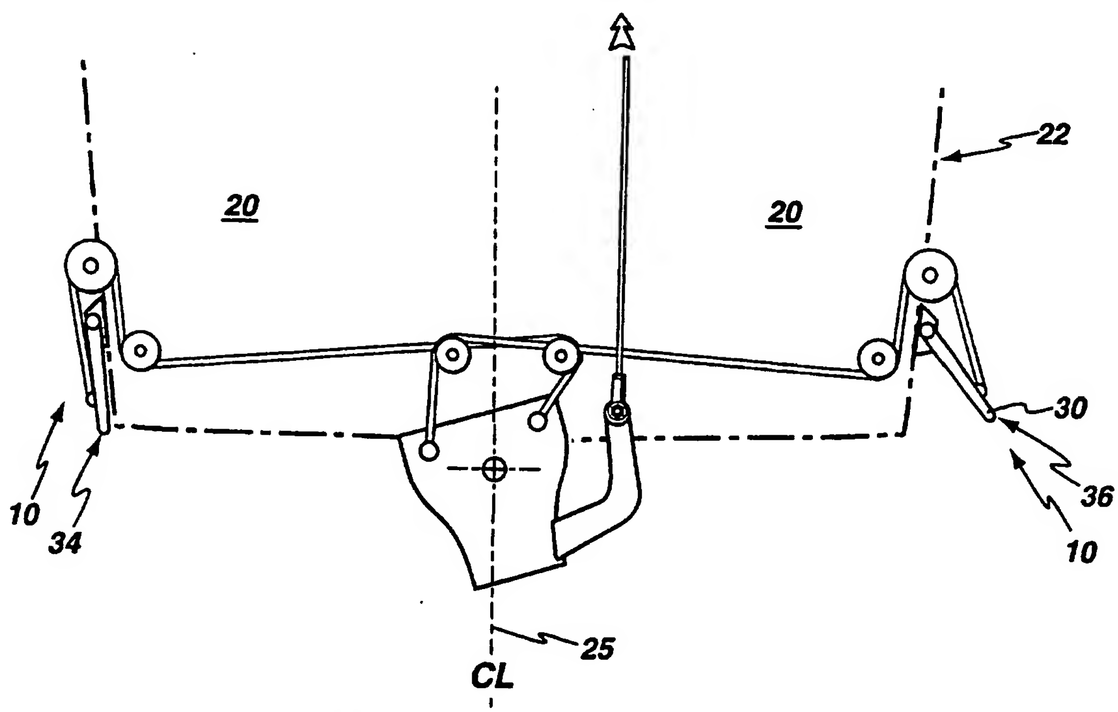

Fig.17